Radio-Loud Coronal Mass Ejections without Shocks near Earth

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Type II radio bursts are produced by low energy electrons accelerated in shocks driven by coronal mass ejections (CMEs). One can infer shocks near the Sun, in the Interplanetary medium, and near Earth depending on the wavelength range in which the type II bursts are produced. In fact, type II bursts are good indicators of CMEs that produce solar energetic particles. If the type II burst occurs from a source on the Earth-facing side of the solar disk, it is highly likely that a shock arrives at Earth in 2-3 days and hence can be used to predict shock arrival at Earth. However, a significant fraction of CMEs producing type II bursts were not associated shocks at Earth, even though the CMEs originated close to the disk center. There are several reasons for the lack of shock at 1 AU. CMEs originating at large central meridian distances (CMDs) may be driving a shock, but the shock may not be extended sufficiently to reach to the Sun-Earth line. Another possibility is CME cannibalism because of which shocks merge and one observes a single shock at Earth. Finally, the CME-driven shock may become weak and dissipate before reaching 1 AU. We examined a set of 30 type II bursts observed by the Wind/WAVES experiment that had the solar sources very close to the disk center (within a CMD of 15 degrees), but did not have shock at Earth. We find that the near-Sun speeds of the associated CMEs average to ~600 km/s, only slightly higher than the average speed of CMEs associated with radio-quiet shocks. However, the fraction of halo CMEs is only ~28%, compared to 40% for radio-quiet shocks and 72% for all radio-loud shocks. We conclude that the disk-center radio loud CMEs with no shocks at 1 AU are generally of lower energy and they drive shocks only close to the Sun.